

Opportunities for Energy Conservation in Apple Storage and Packing Facilities: A Case Study Example from Central New York State

Apple storage and packing facilities often present numerous opportunities for energy conservation measures. Generally, the options include:

- 🔧 General and task lighting efficiency improvements
- 🔧 Variable speed drives on evaporator fans
- 🔧 Variable speed drives on cooling tower pumps
- 🔧 Refrigeration system updates

Following are several recommendations for energy efficiency improvements at a large apple storage and packing facility in central New York State:

1. Consider installing a **variable speed drive** on the cooling tower circulation pump to match pumping rate to required heat rejection rate.
 - a. *The use of a variable speed drive on the cooling tower pump varies the speed of the pump to produce only as much flow to meet desired heat rejection rate from the refrigeration compressors.*
 - b. *Variable speed drives can reduce pump energy use by 40 – 60% during times when full flow is not needed.*
 - c. *Reductions of cooling tower pump operating load can payback the installation of a variable speed drive in 2.6 years.*
 - d. *Reduced operating speed and temperatures can extend motor and pump life.*
 - e. *Qualify for NYSERDA Smart Equipment Choice rebate*

2. Addition of a **refrigeration heat recovery unit** to the pasteurization ice builder refrigeration compressor.
 - a. *A refrigeration heat recovery unit uses the heat removed by the refrigeration compressor while building ice to preheat water to 100 to 115 °F. This preheated water is stored in an insulated tank. The preheated water then flows to the water heater/boiler, significantly reducing heating requirements.*
 - b. *Reduce energy consumption by the oil fired water heater by 50-60%*
 - c. *A refrigeration heat recovery unit would pay for itself in 3.7years.*
 - d. *Additional benefits include increase of refrigeration compressor efficiency during warm summer months because waste heat is more easily transferred to ground temperature water than ambient air. .*
 - e. *Availability of “free” warmed water hose down and miscellaneous cleaning procedures directly from the heat recovery tank(s).*

3. Adoption of **variable speed drive** on evaporator fan motors in controlled atmosphere storages. Controlling fan speed operation to match air delivery requirements of cooling loads and significantly reduce fan energy use.
 - a. *Potential reduction of fan energy consumption by 24 – 78% after pulldown of field heat.*
 - b. *Provide a slightly lower average mass loss of fruit.*
 - c. *A variable speed evaporator fan control system could pay for itself in 2.7 years.*
 - d. *The Cascade Energy website (www.CascadeEnergy.com) is a good reference on evaporator fan variable speed drive applications on fruit storages.*
 - e. *Qualify for NYSERDA Smart Equipment Choice rebate*

4. Replacement of electromagnetic ballasts and T 12 fluorescent lamps in existing fixtures primarily throughout the Cider Mill, office, packing & grading area with **electronic ballast and T-8 fluorescent lamps**. This retrofit offers:
 - a. *Greatly increased energy efficiency. The combination of electronic ballasts and T-8 fluorescent lamps reduce fixture energy use by up to 20%*
 - b. *Could be scheduled during packing line down time in July.*
 - c. *Will provide a payback of 5.1 years to recover initial investment*
 - d. *Qualify for NYSERDA Smart Equipment Choice rebate*

5. Replacement of 200 watt incandescent lamps in packing area with new **enclosed 4' fluorescent fixtures with electronic ballasts and T-8 lamps**. These new fixtures offer:
 - a. *Greatly increased energy efficiency. Each fluorescent fixture reduces energy consumption by 65% while providing 50% more light output than the 200 watt incandescent replaced.*
 - b. *Fluorescent lamp life is greatly extended. Up to ten times greater than incandescent lamps.*
 - c. *Enclosed fixtures less prone to breakage.*
 - d. *Will provide a payback of 3.1 years to recover initial investment*
 - e. *Qualify for NYSERDA Smart Equipment Choice rebate*

6. Replacement of 200 watt incandescent lamps in basement and upstairs storage areas with **42 watt screw-in compact fluorescent lamps (CFL)**
 - a. *Greatly increased energy efficiency, reduction of 150 watts per lamp while maintain similar light output*
 - b. *Simple screw in retrofit. (Use of a protective cover over the CFL is recommended to protect investment in lamp)*
 - c. *CFL can last up to 10 times longer than incandescent bulbs*
 - d. *Provide a very quick payback of 1.6 years to recover initial investment*

7. Replacement of 200 watt incandescent lamps in the “cider mill”, “big” and “packed” apple coolers with **150 watt Pulse Start Metal Halide fixtures**. These fixtures offer:
 - a. *Greatly increased energy efficiency. A 200-watt incandescent lamp can be replaced with a 150- watt pulse start metal halide, reducing energy use by 25% and producing 50% more light output.*
 - b. *Will provide a payback of 4.0 years to recover initial investment*
 - c. *Qualify for NYSERDA Smart Equipment Choice rebate*

8. After “pulldown” of field heat in controlled atmosphere and refrigerated storages, operate smallest possible refrigeration compressor as primary unit. Typically, smaller compressors, operating more hours are more efficient than cycling larger units with short run times. Operating the smallest primary compressor to meet the load will also reduce demand.

9. Consider thermo-graphic scan of original cooler insulation to determine areas of excessive heat loss and potential for retrofit with higher insulation levels.

The chart on the following page provides a full summary of the recommended measures, potential energy savings and implementation costs.

Summary of Energy Conservation Measures Implementation Costs and Savings

Energy Conservation Measure	Energy Saved	Total Annual Dollars Saved (\$)	Implementation Estimated Costs (\$)	Simple Annual Payback Period
1) Install “ <i>variable speed drive</i> ” on cooling tower pump motor to match pumping rate to heat rejection rate.	7,500 kWh	\$1,500	\$4000 (\$200 NYSERDA incentive)	2.6
2) Addition of “ <i>refrigeration heat recovery unit</i> ” to ice builder refrigeration comp to preheat water for cleaning	351 Gal of Fuel oil	\$858	\$3,250	3.7
3) Install “ <i>variable speed drives on evaporator fan motors in Controlled Atmosphere Storages</i> ” to reduce fan operating time optimized for apple storage needs.	22,989 kWh	\$4368	\$12,000 (\$200 NYSERDA incentive)	2.7
4) Retrofit existing T-12 fluorescent lights with “ <i>Electronic ballasts and T-8 fluorescent lamps</i> ” in the cider mill, office, and packing & grading line.	2,600 kWh	\$527	\$3,000 (\$335 NYSERDA incentive)	5.1
5) Replacement of 200 watt incandescent lamps in packing and grading area with “ <i>Enclosed 4’ fluorescent fixtures with Electronic ballasts and T-8 lamps</i> ”	4,700 kWh	\$940	\$3,125 (\$175 NYSERDA incentive)	3.1
6) Replacement of 200 watt incandescent lamps with “ <i>42 watt compact fluorescent lamps</i> ” in the basement and upstairs storage areas	1,500 kWh	\$313	\$500	1.6
7) Replacement of 200 watt incandescent bulbs in all coolers with “ <i>150 watt Pulse Start Metal Halide fixtures</i> ”	2,642 kWh	\$528	\$2,550 (\$425 NYSERDA incentive)	4.0
Total:	41,931 kWh	\$9,034	\$27,090	3.0